

ALIEN SPECIES OF LEPIDIUM (CRUCIFERAE)
IN HAWAII

REED C. ROLLINS¹

The incidence of weeds in the flora of Hawaii is very high compared to that for other land areas of similar size. This is understandable, given the heavy destruction of the native flora at lower elevations, mainly for agricultural purposes, and the fact that Hawaii has long been a crossroads for international commerce and thus for weed seeds from all over the world. In a genus like *Lepidium*, which has many widespread weedy species, one would expect to find at least several species as components of the present-day Hawaiian flora. Oddly enough, only *L. virginicum* L. has been widely recognized as an alien (Hillebrand, 1888; Fagerlund, 1947; St. John, 1973).

Apparently the introduced species have not been closely studied in recent years, and there are indeed several more than one. These are all annuals, or winter annuals, in their native regions, but in Hawaii perennation sometimes occurs. They are markedly different from the species of *Lepidium* native to the Hawaiian Islands, which are shrubs or subshrubs and have been characterized as "bizarre" in contrast to the usual herbaceous taxa (Fosberg, 1972). Fosberg (1969) commented on one of these species, *L. bidentatum* Montin, and concluded that it occurs in its typical form on most of the coral islands of the southern, central, and eastern Pacific. *Lepidium bidentatum* appears to have provided the basic genetic stock from which the taxa of *Lepidium* indigenous to Hawaii have originated. These include *L. bidentatum* var. *o-waihense* (Cham. & Schldl.) Fosb., *L. bidentatum* var. *remyi* (Drake) Fosb., *L. arbuscula* Hillebrand, and *L. serra* H. Mann. *Lepidium orbiculare* H. St. John (1981) appears to be a variant of *L. serra*. If this assumption as to the origin of the native taxa is correct, the evolutionary development of *Lepidium* in Hawaii is consistent with that of other groups of Hawaiian biota where a single source provided the base for the diversity now present (see Carlquist, 1970). That there are no nonwoody species of *Lepidium* indigenous to Hawaii is also consistent with the fact that other genera of the Cruciferae are often woody on isolated islands while their relatives on continental land masses are herbaceous.

The following key has been developed to aid in the identification of these taxa. Under each species brief comments are given to emphasize distinctive characteristics and points of special interest.

¹Gray Herbarium, 22 Divinity Avenue, Cambridge, Massachusetts 02138.

KEY TO THE ALIEN SPECIES OF *LEPIDIUM* IN HAWAII

- A. Cauline leaves fasciculate; plants completely glabrous; siliques broadly oblong, distinctly longer than broad, the apical notch shallow, with margins barely exceeding short style. 1. *L. hyssopifolium*.
- A. Cauline leaves single; plants with at least some trichomes on stems; siliques rotund to only slightly longer than broad, the apical notch prominent, with margins definitely exceeding style.
 - B. Cauline leaves simple, incised to entire; plants branched above or beginning near base.
 - C. Petals conspicuous, equaling or exceeding sepals; infructescences nearly same diameter almost to apex; siliques 2.5 mm or more long. . . 2. *L. virginicum*.
 - C. Petals absent or minute; infructescences narrowing toward apex; siliques 2 mm or less long. 3. *L. densiflorum*.
 - B. Cauline leaves pinnately lobed, lobes entire to sparsely dentate; plants branched beginning near base.
 - D. Plants leafy up to infructescences, usually more than 2 dm tall; leaves often densely hirsute with large trichomes, each segment tapering to sharp, apiculate point; infructescences markedly narrowing toward apex. 4. *L. bonariense*.
 - D. Plants with few leaves, usually less than 2 dm tall; leaves sparsely hirsute with small trichomes to glabrous, the segments oblong, obtuse or nearly so; infructescences narrowing only slightly toward apex. 5. *L. oblongum*.

1. ***Lepidium hyssopifolium*** Desv. J. Bot. Agric. 3: 17. 1814.

Outstanding features of *Lepidium hyssopifolium* are the mostly entire, linear, fasciculate cauline leaves, the small, broadly oblong siliques with a shallow sinus at the apex, the nearly sessile stigmas, the narrow, elongated infructescences, and the nearly glabrous plants. The Hawaiian specimen is completely glabrous. The branches tend to be strongly ascending, and the plants are usually taller than 4 dm.

Lepidium hyssopifolium was described from Australia, where it has become a widespread weed. There seems to be some question as to its provenance. Carolin and Hewson (1981) suggested that the species may have been introduced from South Africa, but Hewson (1981) listed it as native. I have seen no evidence that *L. hyssopifolium* is an alien in Australia, although I have not researched the point thoroughly. On the other hand, Burbidge and Gray (1970, p. 186) described it as "a native species widespread in higher rainfall areas of temperate Australia." According to Thellung (1906), the type came from Hawkesburg, New South Wales, and was collected by Ferdinand Bauer. It is doubtful whether the glabrous phase, named *L. pseudo-hyssopifolium* by Hewson (1981), is a distinct taxon. Many species of *Lepidium* have both pubescent and glabrous phases, often growing together.

The Hawaiian record is based on a single collection: Ahumoa, by abandoned radio facility at 7040 ft elev., 21 May 1975, *Herbst & Spence 53211* (BISH). Since this collection is very similar to those from Australia, it is probable that *L. hyssopifolium* was introduced from there to Hawaii.

2. **Lepidium virginicum** L. Sp. Pl. 645. 1753.

Among the annual species of *Lepidium* presently known in Hawaii, *L. virginicum* is the only one with conspicuous petals that equal or exceed the sepals in length. The plants are usually single stemmed and branched above the middle. It is only when the plant has been trampled or the main stem has been altered at an early stage of growth that branching occurs at lower levels. Compared to the other weedy *Lepidium* species of Hawaii, *L. virginicum* has larger, more rotund siliques. It is by far the commonest of the group.

3. **Lepidium densiflorum** Schrader, Index Sem. Horti Acad. Göttingen. 4. 1832.

In areas where both *Lepidium densiflorum* and *L. virginicum* occur as weeds, the two species are frequently confused. They can be readily distinguished because *Lepidium densiflorum* is apetalous (or if petals are present, they are minute), whereas *L. virginicum* has conspicuous petals that usually exceed the sepals in length. The flowering and fruiting racemes are very dense, as implied by the name, in *L. densiflorum*, and the fruiting racemes are narrow, further narrowing toward the apex; in *L. virginicum* the racemes are less dense, and they maintain the same diameter nearly to the top. In addition, the siliques of *L. densiflorum* are much smaller than those of *L. virginicum*.

4. **Lepidium bonariense** L. Sp. Pl. 645. 1753.

In its native South America, *Lepidium bonariense* L. is a widespread weed, and there is considerable variation in the abundance of trichomes on the leaves and stems. Specimens with the densest trichome covering appear to be centered in Brazil, while several from Argentina, determined by Hitchcock (1945b) as *L. bonariense*, are nearly glabrous except for the upper stems and pedicels. The one specimen we have seen from Hawaii (roadside weed, along Saddle Road on Waimea side of Pohakuloa State Park, 20 May 1975, *Herbst 5336* (BISH)), is densely pubescent, matching specimens from Brazil in this respect. However, there is a range of variation in the density of trichomes among material of *L. bonariense* from Australia, where the species is obviously alien. This suggests that such variation is usual in the species.

Features of *Lepidium bonariense* important for identification include the leafiness up to the infructescences, the relatively erect branches that tend to overtop the main axis, the minute (or absent) petals, the coarse simple trichomes usually present on both surfaces of the leaves and on the lower stems, and the pinnately lobed cauline leaves. The plants are characteristically single stemmed, but the branching may begin fairly low on the main stem axis.

Outside of South America, *Lepidium bonariense* has been widely recognized as an alien weed.

5. **Lepidium oblongum** Small, Fl. S.E. U. S. 468, 1331. 1903.

This is a low-growing species, seldom to 2 dm tall, with branches beginning at or near the base. In the Hawaiian material the fruit has a characteristic

U-shaped sinus and the margins of the siliques are fringed with minute trichomes. The pedicels are usually spreading, somewhat flattened, and covered with trichomes on their adaxial surfaces. The cauline leaves are few and deeply pinnately lobed. Most fully mature plants have lost the basal leaves. Both glabrous- and fringed-fruited plants occur in the southwestern continental United States and Mexico. The fringed condition is more prevalent westward from Arizona to California and southward through most of Mexico than it is in Arkansas, Oklahoma, and Texas.

One or two features of the Hawaiian material point to Mexico as a possible source for this introduction. One, stressed by Hitchcock (1945a), is late shedding of the sepals. In most plants of the species, they are shed very early: usually only two to four fully open flowers near the tip of the inflorescence will have retained them. In the Hawaiian specimens the sepals are retained in five to eight flowers of the upper inflorescence, a tendency also shown in several Mexican specimens. In addition, fruits of the Mexican specimens are more consistently fringed with trichomes than are those from elsewhere; since the Hawaiian specimens all show this feature, it rates as minor evidence in favor of a Mexican origin for the Hawaiian alien.

ACKNOWLEDGMENTS

This study arose from my review of the Cruciferae of Hawaii, requested by the authors (Warren L. Wagner, Derral Herbst, and S. H. Sohmer) of a manual of the flowering plants of Hawaii now in preparation. It is based mainly on material loaned by the Bishop Museum, for which I hereby express my appreciation.

LITERATURE CITED

- BURBIDGE, N. T., & M. GRAY. 1970. Flora of the Australian Capital Territory. 447 pp. Australian National University Press, Canberra.
- CARLQUIST, S. 1970. Hawaii, a natural history. 463 pp. The Natural History Press, Garden City, New York.
- CAROLIN, R. C., & H. J. HEWSON. 1981. Cruciferae (Brassicaceae). Pp. 94–102 in J. JESSOP, ed., Flora of central Australia. A. H. & A. W. Reed Pty., Ltd., Sydney.
- FAGERLUND, G. O. 1947. The exotic plants of Hawaii National Park. Natural History Bulletin 10: 1–62 (mimeographed). National Park Service, U. S. Dept. Interior, Washington, D. C.
- FOSBERG, F. R. 1969. Miscellaneous notes on Hawaiian plants. 5. Occas. Pap. Bernice Pauahi Bishop Mus. 24: 10–24.
- . 1972. Guide to excursion III, Tenth Pacific Science Congress. revised ed. 249 pp. Univ. Hawaii, Honolulu.
- HEWSON, H. J. 1981. The genus *Lepidium* L. (Brassicaceae) in Australia. Brunonia 4: 217–308.
- HILLEBRAND, W. 1888. Flora of the Hawaiian Islands. lxxi + 673 pp. B. Waterman & Co., New York.
- HITCHCOCK, C. L. 1945a. The Mexican, Central American, and West Indian lepidia. Madroño 8: 118–143.
- . 1945b. The South American species of *Lepidium*. Lilloa 11: 75–134.

- ST. JOHN, H. 1973. List and summary of the flowering plants in the Hawaiian Islands. 519 pp. Pacific Tropical Botanical Gardens Memoir No. 1. Cathay Press Ltd., Hong Kong.
- . 1981. *Lepidium orbiculare* (Cruciferae) of Kauai. *Phytologia* **47**: 371–373.
- THELLUNG, A. 1906. Die Gattung *Lepidium* (L.) R. Br. *Mitt. Bot. Mus. Univ. Zürich* **28**: 1–340.